MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

VOL. XXIII. MAY, 1895. No. 5.

INTRODUCTION.

The REVIEW for May, 1895, is based on reports from 3,315 stations occupied by regular and voluntary observers. These reports are classified as follows: 148 reports from Weather Bureau stations; 35 reports from U. S. Army post surgeons; 2,794 monthly reports from State Weather Service and voluntary observers; 30 reports from Canadian stations; 96 reports through the Southern Pacific Railway Company; 521 marine reports through the cooperation of the Hydrographic Office, Navy Department, and New York Herald Weather Service; weekly or monthly reports from 30 U. S. Life-Saving stations; monthly reports from local services established in all States and Territories; and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

The WEATHER REVIEW is prepared under the general editorial supervision of Prof. Cleveland Abbe. Unless otherwise specifically noted, the text is written by the Editor, but the statistical tables are furnished by the Division of Records and Meteorological Data, in charge of Mr. A. J. Henry, chief of that division.

CHARACTERISTICS OF THE WEATHER FOR MAY, 1895.

The barometric pressure was generally in excess east of the Rocky Mountains, and with this there was an excess of sunshine, deficiency of rainfall, and excess of temperature. Injurious frosts occurred in many States, especially on the 13th, 14th, 19th, 20th, and 21st. The local storms and tornadoes on the 3d were a special feature of this month. The stage of waters in the Mississippi and tributaries was generally low.

ATMOSPHERIC PRESSURE (*in inches and hundredths*).

The distribution of mean atmospheric pressure reduced to sea level, as shown by mercurial barometers not reduced to standard gravity and as determined from observations taken daily at 8 a. m. and 8 p. m. (seventy-fifth meridian time), is shown by isobars on Chart II. That portion of the reduction to standard gravity that depends on latitude is shown by the numbers printed on the right-hand border.

During the current month the highest mean pressures were in the south Atlantic and east Gulf States. The extreme highest were: Charleston, 30.11; Lynchburg, Raleigh, Knoxville, and Chattanooga, 30.10; Washington and Hatteras, 30.09. The lowest mean pressures were in New Mexico, Arizona, and southern California, as also in Assinniboia. The extreme lowest were 29.78 at Yuma and 29.80 at Calgary.

As compared with the normal for May the mean pressure for the current month was decidedly in excess over the whole country east of the Mississippi. The maximum excesses were: Parkersburg, Lynchburg, and Lexington, 0.09; Nantucket, New London, Cincinnati, St. Louis, Raleigh, and Augusta, 0.08. Pressure was slightly deficient in the upper Missouri Valley and British provinces. The maximum deficits were: Edmonton and Calgary, 0.08; Yuma, 0.06.

As compared with the preceding month of April the pressures reduced to sea level show a rise in the Atlantic and east Gulf States; the maximum rises were: 0.10 at Father Point, 0.09 at Quebec, and 0.08 at Knoxville and Cairo. Elsewhere the pressure generally fell; the maximum falls were: Williston and Keeler, 0.13; Minnedosa, St. Vincent, Duluth, Salt Lake City, Winnemucca, and Yuma, 0.12.

HIGH AND LOW AREAS.

By PARK MORRILL, Forecast Official.

The storm areas of this month were all of a kind that may be termed the Northwest type. Of these areas of low pressure perhaps all have their ultimate origin over the North Pacific Ocean, although some are first observed in the western Canadian provinces, and occasionally one forms, possibly as a secondary to a more northerly main depression, in the Dakotas or Minnesota. Three of the latter sort are included in the low areas of this month. The general course of storms of this character is along the arc of a circle, first moving southeast into the upper Missouri and Mississippi valleys, then east across the Lake region or central valleys, and lastly northeast, most commonly into the Gulf of St. Lawrence, whence they disappear over the Atlantic Ocean.

The movements of the various centers of low pressure are shown in detail on Chart I. An examination of the tracks indicates that, except for a secondary which formed in extreme western Nebraska, and after remaining nearly stationary for three days in Nebraska and Kansas, finally was absorbed into another depression, and for a further temporary incursion of area II into Kansas, all the tracks lie north of the fortieth parallel. It is rather remarkable that no storm of the Southwest type was experienced during the entire month.

The tracks of high pressure areas for the month, as shown on Chart IV, are much more widely distributed. Area I was remarkable for its southwest movement along the Atlantic coast from the 1st to the 4th. The persistence of high pressure on the Pacific coast is a noticeable feature of the month.

On no less than fifteen days an area of high pressure is clearly indicated on the coast of northern California, Oregon, or Washington. The general type of high areas of this month was that which appears in the western Canadian provinces and advances southeast along the Rocky Mountain slopes, either to the Gulf of Mexico or turning eastward across the central valleys to the middle Atlantic coast.

HIGH AREAS.

Six areas of high pressure are plotted on Chart IV, brief descriptions of which are given below.

I.—The month opened with an extensive area of high pressure central in the lower St. Lawrence Valley. By the evening of the 1st this had moved southeast across northern New England to the ocean. During the 2d and 3d this area of high pressure apparently moved southwest, outside the coast line, the center again reaching land, on the South Carolina coast, at the a. m. observation of the 4th. At the p. m. observation of the 4th this area had seemingly been absorbed into a vast high area which existed over the Atlantic, as indicated by the continued high pressure at Bermuda. The entire anomalous movement of this area was apparently a part of the phenomena attendant on the pressure of this great Atlantic high. During this period rains, at one or two points of considerable amount, fell in the middle and south Atlantic districts. The western edge of the area of high pressure, which existed over the ocean, covered the northern coast until the 8th and continued evident in the South two days longer.

II.—This area was remarkable in the length of time during which it was an effective feature of our weather conditions. It appeared off the south Pacific coast at the p. m. report of the 2d. Its course was then northward along the coast until the morning of the 9th; then, turning eastward, it crossed the mountains and followed their eastern slope southward until it finally passed off the Texas coast during the night of the 12th. It was thus clearly identified for a period of ten days. During its movement along the Rocky Mountain slope it was accompanied by freezing temperatures and general frosts in Montana, the Dakotas, Nebraska, Kansas, and Colorado.

III.—This area developed during the night of the 12th in the upper Missouri Valley, and advanced southeast and east for two days. At the end of that time it had become a narrow belt of high pressure stretching from Upper Michigan to South Carolina; it subsequently flattened out and disappeared. It was accompanied by killing frosts in the upper Mississippi Valley. The frost area extended so far east as to embrace Upper Michigan, Indiana, and western Kentucky.

IV.—The fourth well-defined high area appeared on the Pacific coast; its approach was heralded by a rapid rise of pressure at Eureka on the 12th. During the following night it apparently moved north, the pressure rising rapidly in western Oregon and Washington. Its northerly movement continued until the evening of the 14th, when the center was apparently situated some hundreds of miles north of our boundary. Its course was then changed to east and southeast, and at the morning report of the 15th the center was located near Calgary. Its subsequent course was nearly straight, in a southeast direction, until it reached the Texan coast on the 18th. It was thus a factor of our weather conditions for six days. During its southerly movement low temperatures accompanied it, but not as severe as those of area II. Frosts occurred in Montana and Colorado.

V.—On the 17th the pressure began to rise in Saskatchewan, and on the morning of the 18th was 30.46 at Prince Albert. The area of high pressure extended, while its center remained nearly stationary, and by the morning of the 19th embraced the northern Rocky Mountain slope and the Missouri and upper Mississippi valleys. Frosts were again reported in South Dakota and Minnesota at this time. On the 19th the center began an advance southeast, which terminated on the Carolina coast on the 23d. After reaching the coast the movement changed to a northeasterly direction, and the western edge of the high area was apparent on the northern coast until the 26th. Very low temperatures accompanied the advance of this area across the central valleys, and frosts were general throughout the upper Missouri and Mississippi valleys, the Lake region, and the Ohio Valley.

VI.—From the 17th to the 23d an area of high pressure was apparently located off the north Pacific coast. On the 24th this high pressure gave way, and on the next day a depression appeared on the Oregon and Washington coast. At the same time a high appeared in Alberta and advanced southward. This seems to have been the same high area which had existed over the ocean, and which followed a similar course to that of No. III, crossing the coast north of our boundary, and then curving to the east and south. As it advanced into the interior of the country the pressure rapidly diminished, and on the evening of the 26th was high only by comparison with the deep depressions which existed on either side of it. On the following morning it had again built up, while advancing eastward. During the 28th it was merged into the general area of high pressure, whose western edge had covered Florida for the previous twenty-four hours. After this junction the latter remained nearly stationary until the end of the month, embracing within its area the region south of the Lakes, and extending westward nearly to the Mississippi River. During this time the center remained outside the coast line.

LOW AREAS.

On Chart I are plotted the tracks of eight centers of low pressures. The average rate of movement of these storms ranges from 15 to 28, the mean rate for all being 21.8 miles per hour. Area VII is remarkable for the very low pressure attained at its center (28.90), and for the energetic secondary which formed in its southern portion. All are noticeable for the high latitude maintained throughout their eastern movement. Details of the individual areas follow.

I.—At the morning observation of the 1st a belt of low pressure covered the Rocky Mountain district, extending from British Columbia to Texas. There were indications of the existence of a center of low pressure far to the northwest, beyond the limits of observation. At the following report the center of low pressure had advanced to the vicinity of Calgary. It remained nearly stationary for the next twenty-four hours, first decreasing and then increasing in depth. At the evening observation of the 2d it was in the vicinity of Medicine Hat, where the pressure had fallen to 29.38 inches. On the morning of the 3d the main center seems to have advanced southeast to the vicinity of Miles City, while subsidiary depressions existed near Qu'Appelle and Valentine, respectively. At the following observation the centers were again united and located between Pierre and Bismarck. Between the evening of the 3d and the morning of the 4th the center turned due northeast, and at the afternoon report of the 4th had reached Winnipeg, after which it passed out of view into the Hudson Bay territory. This disturbance was accompanied by rain far to the southeast of the center, reaching even to the Gulf. This fact is, however, probably to be attributed in part to the presence of an area of high pressure on the Atlantic coast, by the action of which the moist air of the Gulf was forced northward through the central valleys.

II.—This depression appeared in the vicinity of Calgary on the evening of the 6th, and for seven days its course is traced across the Northwest, the lower Lake region, and the St. Lawrence Valley, until it finally reached the Gulf of St. Lawrence on the night of the 13th. Its track is noticeable

for the abrupt movements southward, which occurred on the 9th and 12th. Both of these movements seem to have been due to the reaction of areas of high pressure adjoining the low. Until the center had reached Kansas, on the 9th, little or no rain had fallen within the area of low pressure. Subsequently light rains fell to the north and northwest of the center.

III.—This area of low pressure was faintly indicated by the reports from Saskatchewan and Assinniboia on the evening of the 11th. On the following morning the center of slight energy was well defined in the vicinity of St. Vincent. Its course was southeast to Illinois and then eastward to the coast near New York, where it arrived on the evening of the 14th. After reaching the Atlantic its course changed to northeast. Striking the coast of Nova Scotia on the evening of the 15th, it moved northward across this province and then recurved to the northwest and disappeared in the Hudson Bay territory.

IV.—The edge of this depression was visible in Alberta on the evening of the 12th. On the following morning the center was well defined in the vicinity of Edmonton, and during the next twenty-four hours advanced eastward to Prince Albert. In the subsequent twenty-four hours it moved south-southeast to South Dakota, and at the same time a depression formed farther south, in southern Kansas. At the next report both had been filled up by an advancing high.

V.—On the 16th there were indications of an area of low pressure on the coast of British Columbia, and on the morning of the 17th there seemed to be an offshoot from this area in Saskatchewan. The sudden advance of a high from the north apparently forced this depression southward to South Dakota, and its subsequent course is traced as track V. Its movement was nearly east to Ontario, and then northeast down the St. Lawrence Valley. Its energy was at no time great, but it was accompanied by considerable rainfall in the Lake region.

VI.—This area was slow in movement, occupying five days in its translation from North Dakota to the province of Quebec. Its first appearance is seen on the p. m. map of the 21st, on which the southern side of a depression is visible in Assinniboia and Montana. The following day the depression seems to have receded northward. On the morning of the 23d either this depression with much diminished energy, or a secondary development from the main area, was central near St. Vincent, and its subsequent movement is indicated by track VI. It remained nearly stationary for thirty-six hours and afterward advanced eastward across the Lake region and down the St. Lawrence Valley. Its energy increased as it approached the Lake region and moderate rains accompanied it. After reaching the vicinity of Quebec, it passed northward into the Hudson Bay territory.

VII.—This depression appeared in British Columbia on the morning of the 25th. Its center seems to have been situated far to the north and to have been advancing eastward in high latitudes until the evening of the 26th. At that time the center was near Edmonton, where the remarkably low pressure of 28.94 inches was reported. It remained nearly stationary during the following twenty-four hours and, at the same time, a second low formed in western Nebraska. These two centers, designated as VII and VII*a*, existed separately and well defined, as portions of one great depression, for thirty-six hours. During this time they moved southward until, on the morning of the 29th, they were found in southern Minnesota and western Kansas, respectively. The more northerly one seems then to have moved rapidly to the northeast, and there are indications that it ultimately reached the Atlantic near Newfoundland. The southerly one was visible for twenty-four hours longer, remaining nearly stationary, and was then absorbed into a new low, which had advanced from the northwest. The progress of this storm was marked by violent winds and, during its latter part, by abundant rains. The depth of the depression was unusual, a barometer of 28.88 being reported at Battleford at 8 a. m. of the 27th.

VIII.—This area of low pressure appeared in Alberta on the morning of the 29th and, after remaining stationary for thirty-six hours, moved rapidly to South Dakota, then returned and reached the vicinity of Winnipeg by the evening of the 31st.

MOVEMENT OF CENTERS.

The following table shows the date and location of the center for the beginning and ending of each area of high or low pressure that has appeared on the U. S. weather maps during the month, together with the average daily and hourly velocities. The monthly averages are computed in two ways; first, by considering each path as a unit, and second, by giving equal weight to each day of observation:

Movement of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	1, a. m.	49	69	4, a. m.	32	79	1,500	3.0	500	20.8
II*	9, a. m.	47	124	13, a. m.	28	91	2,600	4.0	650	27.1
III	13, a. m.	45	95	15, a. m.	40	82	700	2.0	350	14.6
IV	15, a. m.	51	115	18, a. m.	31	97	1,700	3.0	567	23.6
V†	19, a. m.	54	105	23, a. m.	36	79	1,900	4.0	475	19.8
VI	25, a. m.	51	107	28, a. m.	39	80	1,800	3.0	600	25.0
Sums							10,200	19.0	3,142	
Mean of 6 paths									524	21.8
Mean of 19 days									537	22.4
Low areas.										
I	1, p. m.	51	113	4, p. m.	50	97	1,100	3.0	367	15.3
II	6, p. m.	51	117	13, p. m.	48	64	4,500	7.0	643	26.8
III	12, a. m.	48	97	17, a. m.	49	64	3,350	5.0	470	19.6
IV	13, a. m.	53	114	15, a. m.	43	99	1,150	2.0	575	24.0
V	17, p. m.	45	99	20, a. m.	49	67	1,650	2.5	660	27.5
VI	23, a. m.	48	98	28, a. m.	48	70	2,050	5.0	410	17.1
VII	26, p. m.	54	113	29, a. m.	44	94	1,350	2.5	540	22.5
VIII	29, a. m.	52	114	31, p. m.	49	96	1,300	2.5	520	21.7
Sums							15,450	29.5	4,185	
Mean of 8 paths									523	21.8
Mean of 29.5 days									524	21.8

*Only that portion of the path subsequent to the center's entrance within the coast line is considered.

†The thirty-six hours during which the center remained stationary where first observed is not considered.

NORTH ATLANTIC METEOROLOGY.

OCEAN FOG FOR MAY.

The limits of fog belts for May, 1895, as determined by reports from shipmasters, are shown on Chart I by dotted shading. Near the Grand Banks of Newfoundland fog was reported on twenty-five days; between the fifty-fifth and sixty-fifth meridians, on 21 dates; and west of the sixty-fifth meridian, on 21 dates. Compared with the corresponding month of the last seven years, the dates of occurrence of fog